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BIPOLAR JUNCTION TRANSISTORS HAVING TRENCH-BASED  
BASE ELECTRODES AND METHODS OF FORMING SAME

Abstract of the Disclosure

Bipolar junction transistors utilize trench-based base electrodes and lateral base electrode extensions to facilitate the use of preferred self-alignment processing techniques. A bipolar junction transistor is provided that includes an intrinsic collector region of first conductivity type in a semiconductor substrate. A trench is also provided in the substrate. This trench extends adjacent the intrinsic collector region. A base electrode of second conductivity type is provided in the trench and a base region of second conductivity type is provided in the intrinsic collector region. This base region is self-aligned to the base electrode and forms a P-N rectifying junction with the intrinsic collector region. An emitter region of first conductivity type is also provided in the base region and forms a P-N rectifying junction therewith. To reduce lateral dimensions and reliance on critical photolithographically defined masking steps, the base electrode is formed to have a lateral base electrode extension that extends along a surface of the substrate. When formed, both the base region and emitter region are self-aligned to the base electrode extension. A trench insulating layer is also disposed in the trench, between the base electrode and the intrinsic collector region. The base region is also configured as an extrinsic base region of second conductivity type that is self-aligned to the base electrode and an intrinsic base region of second conductivity type that is self-aligned to a sidewall of the base electrode extension. The emitter region is also preferably self-aligned to the sidewall of the base electrode extension.